STATE OF CALIFORNIA

AIR RESOURCES BOARD

AIR MONITORING QUALITY ASSURANCE

VOLUME II

STANDARD OPERATING PROCEDURES

FOR

AIR QUALITY MONITORING

APPENDIX H

MONITOR LABS MODEL 9400 TELEMETRY SYSTEM DATA LOGGER

MONITORING AND LABORATORY DIVISION

DECEMBER 1979

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STATE OF CALIFORNIA

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APPENDIX H.1

STATION OPERATOR'S PROCEDURES
FOR THE
MONITOR LABS MODEL 9400 TELEMETRY SYSTEM DATA LOGGER

MONITORING AND LABORATORY DIVISION

DECEMBER 1979

H.1.0 GENERAL INFORMATION

H.1.0.1 FUNCTION OF THE DATA LOGGER - Upon command from the central station's system controller, the Model 9400 Data Logger scans the analog outputs of each air monitoring instrument, converts the analog signals to a binary coded decimal format, modulates the binary signal using the frequency shift key (FSK) modulation technique, and transmits the modulated signal to the telemetry central via a voice grade telephone line. Each data logger on the ARB telemetry system is scanned at 5-minute intervals by the telemetry central in Sacramento. The central system controller converts the air quality data to a useable format such as hourly averages, hourly peaks and 24-hour averages. The data are automatically printed out every hour. A station can also be scanned manually via the telemetry central's control console.

Table H.1.0.1 shows the air monitoring stations on the ARB telemetry system with their telemetry station ID and select code numbers.

H.1.0.2 CAUTIONS

1. To insure reliable, trouble-free operation, the AC power supply to the data logger should be free of large voltage transients and other line noise.

2. To prevent the telemetry central from receiving invalid data, always place the "AUTO" switch in the out (off) position when performing a manual scan.

TABLE H.1.0.1

AIR RESOURCES BOARD TELEMETRY SYSTEM

Station Number	Station Location	ID	Select Code	Thumbwheel Setting
1	Chico	CIC 628	1	61
2	Willows	WLW 674	2	62
3	Woodland	WOD 569	9	71
4	Rocklin	ROC 810	?	77
5	Folsom	FOL 287	0	60
6	Sacramento	SAC 282	1	61
7	Fresno	FAT 234	2	62
8	Visalia	VIS 568	9	71
9	Bakersfield	BFL 203	3	63
10	San Jose	SJC 382	3	63
11	Santa Maria	SMX 364	8	70
12	Santa Barbara	SBA 355	4	64
13	Simi	SIM 413	0	60
14	Azusa	AZU 060	4	64
15	Upland	UPL 175	5	65
16	Riverside	RAL 146	6	66
17	La Habra	LAH 177	7	67
18	Dola	LOS 001	7	67
19	Lennox	LNX 076	8	70
20	Mt. Lee	MLE 581	5	65
21	Palm Springs	PSP 137	6	66

NOTE: The Select code for Rocklin is ASCII character "?" (question mark) which is Select Code "77".

H.1.1 PHYSICAL DESCRIPTION OF THE DATA LOGGER (See Figure H.1.1.1)

H.1.1.1 DISPLAY - The LED display indicates the channel being scanned or monitored and the voltage output of the instrument on that channel.

H.1.1.2 CONTROL THUMBWHEEL AND SWITCHES

1. FIRST POINT. These two thumbwheel switches determine the first channel to be scanned. Set the switches to 00 for normal operation.

2. LAST POINT. These two thumbwheel switches determine the last channel to be scanned. Set these switches to correspond with the number of data channels in operations at the station. For example, if you have the first six channels in use, set the switches to 05.

3. MON. These thumbwheel switches determine the channel that is monitored and displayed in the monitor or data mode. Set these to the channel you wish to monitor.

4. SINGLE. When pushed in, this push button switch places the scanner control in the single scan mode. Upon each manual or external start command, all channels are scanned once from the first point to last point. Push this switch in (on) for normal operation.

5. CONT. When in, this push button switch places the scanner in the continuous scan mode. Upon each manual or external start command, all channels are continuously scanned from the first point to last point. This switch is out (off) for normal operation.

6. MANUAL. When in, this push button switch causes the scanner to select the first analog channel after receipt of a start command. Subsequent start commands cause the scanner control to advance one channel for each command. The system scanner will continue to advance as long as start commands continue. This switch is out (off) in normal operation.

7. REMOTE. This push button switch is inoperative in ARB telemetry system data loggers and should be out (off) for normal operation.

8. RECORD. This push button switch, when depressed, enables control and printout on the printer. This switch is inoperative in those ARB telemetry system data loggers without printers and should be out (off) for normal system operation.

9. A. This push button switch is used to perform the local modem test in ARB telemetry system data loggers and should be out (off) for normal operation.

10. B. This push button switch is used to perform the local modem test in ARB telemetry system data loggers and should be out (off) for normal operation.

11. MDE. This push button switch is inoperative in ARB telemetry system data loggers and should be out (off) for normal operation.

12. START. Depressing the start switch initiates the scanner in all three modes: SINGLE, CONT. AND MANUAL.

13. RESET. This switch provides a master reset to the control and interface cards to clear the logic. If a scan has started, depressing this switch terminates the scan and restarts the control logic at the beginning of the control program. This switch is also used to initiate the local modem test.

14. DATA. When this switch is depressed, the readout will display the channel number and voltage reading during scan modes.

15. MON. When this switch is depressed, the readout will display the channel selected by the MON thumbwheels (#3) when the system is not scanning in the CONTINUOUS mode. The channel selected will be displayed and continuous updated. Push this switch in (on) for normal operation.

16. AUTO. When depressed, this switch causes the data logger to be placed on the telephone line to the telemetry central. Push this switch in (on) for normal operation.

17. REM/OFF. The remote switch located on the rear of the Modem Card (J6) will initiate a test mode called the "echo" function by disconnecting the modem from its associated data terminal and connecting the receiver output to the transmitter input. With the switch in the "REM" position, data received from the telemetry central will be returned to the telemetry central. This two position switch should be in the "OFF" position for normal operation.

18. LOC/OFF. The local test switch on the rear of the data logger on the Modem Card will initiate the local modem test. For normal operation this switch must be in the "OFF" (down) position.

19. BAUD RATE SELECT. The baud rate (the rate at which data transmission takes place) of the ARB telemetry network is 300 baud. Set the baud rate select switch on the rear of the data logger to the "150X" (down) position and the multiplier thumbwheel to "2".

NOTE: For normal operation, all three toggle switches on the rear of the data logger must be in the down position.

H.1.1.3 LABEL THUMBWHEELS

1. Label Explanation - The 10 thumbwheel switches, corresponding to the 10 data channels, indicate the status of the analyzer associated with each channel. A thumbwheel position of "O" indicates the analyzer is in service and generating valid data. A thumbwheel position of "1" indicates the analyzer is out of service (off, being zeroed, being spanned).

2. Label Identification - Reading from left to right, the thumbwheels correspond to the following channels and pollutants:

Channel	Pollutant
00	Oxidant (Ox) or Ozone (O3)
01	Nitrogen Dioxide (NO2)
02	Total Oxides of Nitrogen (NOx)
03	Carbon Monoxide (CO)
04	Total Hydrocarbons (THC)
05	Coefficient of Haze (COH)
06	Wind Speed (Knots)
07	Wind Direction (Deg)
08	Sulfur Dioxide (SO2) or Visibility (Vis)
09	Back Scattering (Bscat) (NEP)

NOTE: The above channel identification list is valid for most air monitoring stations in the network. However, special circumstances may require slightly different configurations in some locations.

H.1.1.4 PRINTED CIRCUIT CARD LOCATION - The following table shows the location of each printed circuit card in the Model 9400 Data Logger Main Frame.

Printed Circuit Card Number	Description of Card	9400 Slot Number
	WTC - Wind Totalizer Card	J2
940D0217	CCI - Contact Closure Input	J4
940D0212	CCO - Contact Closure Output	J3
940D370	Modem Card	J6
940A0266	SIO - 1 (Supervisory I/O)	J7 & J8
940D0082	Dual Digitizer	J10
940C0078	Switch Driver	J12
122B0039	Analog Input Switch Card	J13
940D0074	Scanner Control	J28
940D0221	Internal System Control Memory	J31

The SIO - 1 (Supervisory I/O) cards located in slots J7 and J8 make up a two-card assembly, which is numbered 940A0266. The Internal System Control Memory located in slot J31 is also a two-card assembly, which is numbered #940D0221.

H.1.1.5 POWER FAILURE PROTECTION CIRCUIT (PFPC) - In the event of a power failure, the standard Model 9400 data logger appears as an open network on that telephone line. To eliminate this problem, the ARB has developed a protective circuit which maintains a constant 600 ohm impedance across the telephone line until power comes on again.

When a power failure occurs at a monitoring station, the protective circuit automatically places a 600 ohm resistor across the telephone line allowing the rest of the telemetry network on that line to operate normally. This device is shown in Figure H.1.2.1. The "ON"/600 OHM" switch on the Power Failure Protection Module must be in the "600 OHM" position when the data logger is turned off or removed from service.

Certain stations in the South Coast have uninterruptable power supplies (UPS) which are activated in the event of a power failure. Therefore, the PFPC will only be used at these locations in the event of an extended power outage (> 8-12 hrs).

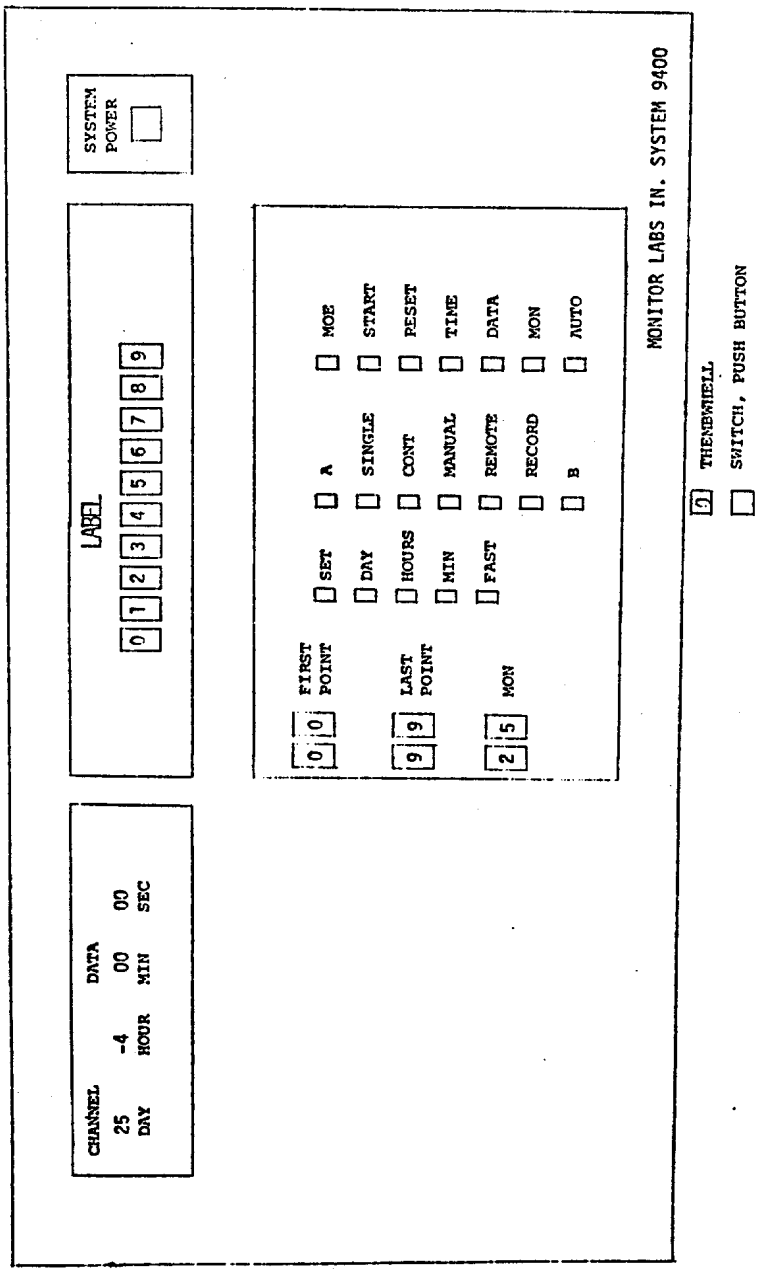

Figure H.1.1.1
Monitor Labs Model 9400 Data Logger Controls

H.1.2 INSTALLATION PROCEDURE

Coordinate the installation and start up all telemetry data loggers with personnel at the telemetry central so the system can be properly programmed to scan and analyze the data transmitted. A complete wiring diagram for the installation of data loggers used in the telemetry system is shown in Figure H.1.2.1. The installation procedure is outlined below.

H.1.2.1 PHYSICAL INSPECTIONS - After the data logger has been removed from its shipping container and inspected for damage, check the printed circuit cards for tightness and proper location in the mainframe.

H.1.2.2 INITIAL CONNECTIONS

1. The data logger is shipped with the terminal card (BTS) and the #010B0149 cable assembly removed. The cable assembly has two plugs, P1 and P2, which you must connect to the modem card in slot J6 and the station select card in slot J8, respectively. These plugs are marked and cannot be interchanged since they are different types. Check the plug that is connected to the modem card in slot J6 to ensure that pins #1 and #A are at the top of the connector when installed.

2. Couple the signal inputs from the analyzers to the data logger by connecting the two conductor shielded cables from the input terminals of the strip chart recorder to the BTS input card. The BTS input card is connected to the Analog Input Switch card in slot J13. The terminals are labeled "H" (High), "L" and "S" (Shield) and are numbered from channels 0 to 9. Connect the H (High) and L (Low) terminals on the BTS card to the + (positive) and - (negative) terminals on the recorder, respectively. Connect the shield to the S (Shield) terminal on the BTS card, but do not terminate it at the recorder.

3. After you have installed the analog data input cables, connect the telephone line to the data logger. Use two conductor cables, shielded or unshielded, to connect the telephone line to the Power Failure Protection Module (PFPM). Connect the telephone cable terminals marked "DR" (Ring) and "DT" (Tip) to terminals #1 and #2 on the PFPM. Polarity on this connection is not important.

The #010B0149 cable assembly (mentioned in #2 above) is used to connect the data logger to the PFPM. Connect the red and green wires (together) from the cable assembly to terminal #3 on the PFPM and the black and white wires (together) to terminal #4 on the PFPM. If the data logger is being installed at a location that has no PFPM, simply connect the red and green wires (together) to one side of the telephone line and the black and white wires (together) to the other side of the line. Again, polarity is not important.

H.1.2.3 CONTROL SWITCH AND THUMBWHEEL SETTINGS

1. There are three toggle switches on the rear of the Model 9400 data logger, two on the modem card in slot J6 and one on the card in slot J7. The two switches on the modem card in slot J6 are the "REM/OFF" switch and the "LOC/OFF" switch. These two switches should be in the "OFF" (down) position for normal system operation. The switch on the Baud rate select card in slot J7 is labeled "X110 x 150". This switch should be in the X150 (down) position for normal operation. The Baud rate thumbwheel switch on the card in slot J6 should be set to "2".

2. Set the select code thumbwheel switches, marked "tens" and "units" located on the SIO - 1 card (#940A0266) to the correct code identification for each air monitoring station. (See Table H.1.0.1 for correct station select codes and thumbwheel settings.)

H.1.2.4 POWER CONNECTIONS - Connect the input power cables from the data logger and the Power Failure Protection Module to a suitable AC power supply, and turn on the units.

H.1.2.5 CHECKOUT - Check for correct positioning of the "Label" (status), "FIRST POINT" and "LAST POINT" thumbwheel switches. Then, after depressing the "SINGLE" and "MON" switches, initiate a local scan. (See Section H.1.4.1). If the system appears to operate normally in the local scan mode, initiate a local modem test (see Section H.1.4.2). After successful completion of this test, the data logger should be set up for normal telemetry operation by depressing the "SINGLE", "MON", AND "AUTO" switches on the data logger and setting the "ON/600 OHM" switch on the Power Failure Protection Module to the "ON" position.

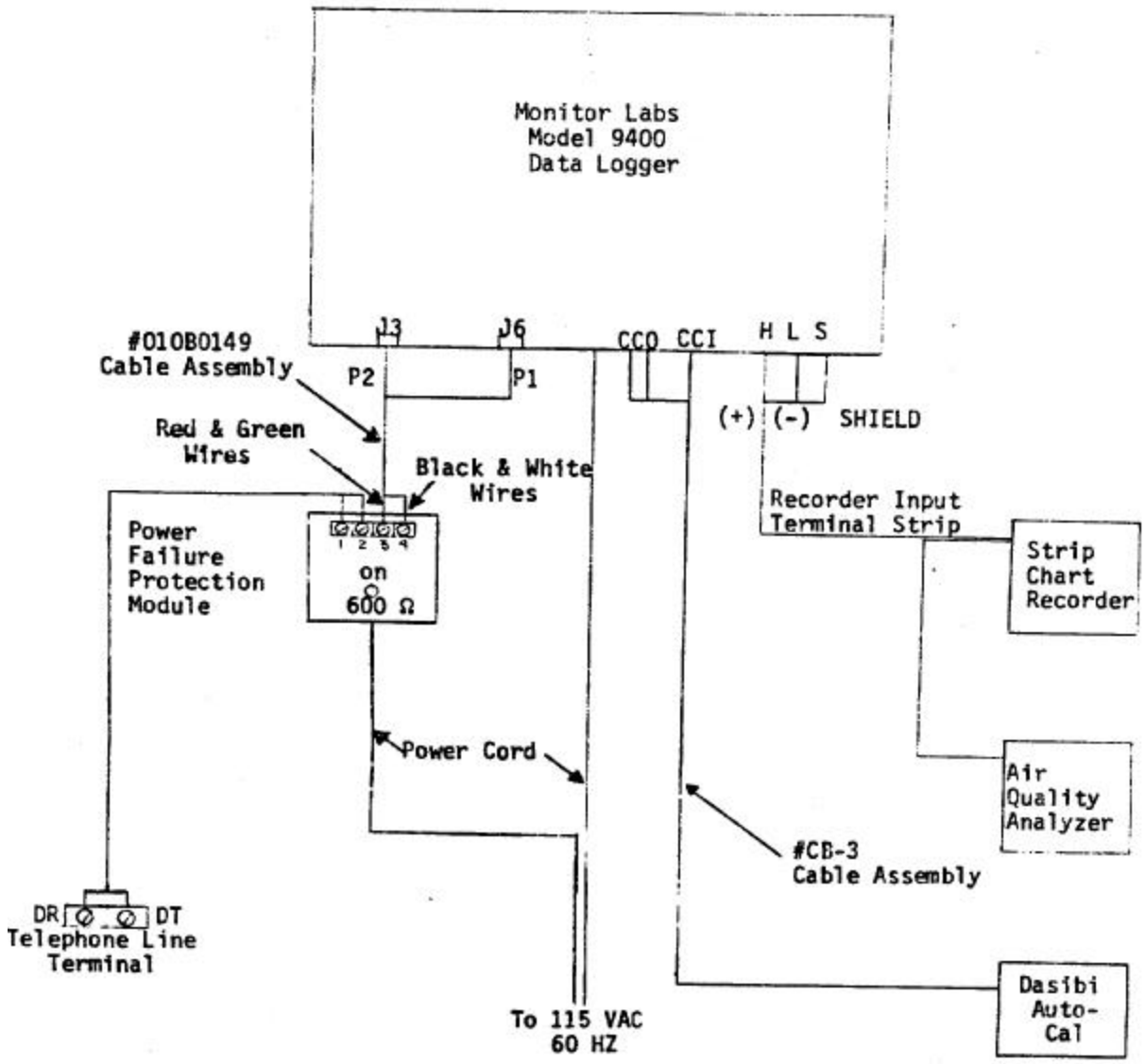

Figure H.1.2.1
Monitor Labs Model 9400 Data Logger Wiring Diagram

H.1.3 ROUTINE SYSTEM CHECKS

H.1.3.1 GENERAL INFORMATION - Perform the following system checks using the schedule and the procedures documented in this Section. Checks may be performed more frequently but should be performed at least at the prescribed intervals. Also attached is a copy of the Monthly Quality Control Maintenance Checksheet (Figure H.1.3.1) which you should complete weekly and forward monthly to your supervisor.

H.1.3.2 WEEKLY CHECKS

1. Push button switch status - Check and record the status of the "POWER" (on or off), "AUTO" (on or off), "MONITOR" (on or off) and "SINGLE" (on or off). These should all be on for normal operation.

2. "FIRST POINT" and "LAST POINT" thumbwheel status - Check and record the setting of the "FIRST POINT" and "LAST POINT" thumbwheel switches.

3. "LABEL" thumbwheel status - Check the position of the "LABEL" thumbwheel switches to ensure that the proper channel status is being transmitted to the telemetry central. Monthly, record the “as found position” of each thumbwheel switch in the upper half of the appropriate block on the checksheet and the reset position of each switch in the lower half of the block.

H.1.3.3 MONTHLY CHECKS

1. Data logger versus recorder input comparison - To compare the data logger millivolt data with actual recorder readings, set the "MON" thumbwheel to each channel and simultaneously read the LED display on the data logger and the millivolt reading on the recorder for that channel. Do this for each channel being telemetered (except wind data). Enter the millivolt reading of the recorder in the upper half of the appropriate block on the checksheet. Enter the millivolt data read on the data logger LED display in the lower half of the block.

2. AISI clock set time - Check the AISI start time by observing the operation of the AISI as it is about to change modes at the end of a normal 2-hour interval. The start should occur 3 to 4 minutes after the hour for station 1 through 9 and 4 to 5 minutes after the hour for station 10 through 20. The timing of the start of the AISI interval is very important for the accurate transmission of valid COH data to the telemetry central in Sacramento. Use the most accurate time

reference available to set this time. If the AISI start time was within limits, enter a check in both the upper and lower halves of the appropriate block on the checksheet. If some adjustment is required, enter the amount of reset required, in minutes, in the upper half of the block, i.e. "+20", "-2" or "+3". If the new adjustment was within limits, enter a check in the lower half of the block on the checksheet.

3. Data logger manual scan - Check the manual scan of the data logger (see Section H.1.4.1). If the data logger responds properly, enter a check in the appropriate block on the checksheet.

CALIFORNIA AIR RESOURCES BOARD
MONTHLY QUALITY CONTROL MAINTENANCE Checksheet
MONITOR LABS MODEL 9400 TELEMETRY SYSTEM DATA LOGGER

Location:_____ Month/Year:_____
Station Number:_____ Technician:_____
Data Logger Property Number:_____ Agency:_____
Operator Instructions:

1) Weekly Checks: Push button switch status; "First Point" and "Last Point" switch status; label thumbwheel status (record monthly).

DATE	POWER (ON/OFF)	AUTO (ON/OFF)	MONITOR (ON/OFF)	"SINGLE" (ON/OFF)	"FIRST POINT"	"LAST POINT"	THUMB-WHEELS CORRECT (YES/NO)
	/	/	/	/	/	/	/
	/	/	/	/	/	/	/
	/	/	/	/	/	/	/
	/	/	/	/	/	/	/
	/	/	/	/	/	/	/

2)Monthly Checks: Data Logger versus Recorder Input comparison; AISI clock set time; Data Logger manual scan.

Channel	00	01	02	03	04	05	06	07	08	09
Parameter	O_3	NO_2	NO_x	CO	THC	COH			SO_2	
Voltage (millivolts)	/	/	/	/	/	/	/	/	/	/
Label switches	/	/	/	/	/	/	/	/	/	/
AISI clock time		/		Manual Scan						

DATE	COMMENTS OR MAINTENANCE PERFORMED

PTSD - 26 (7/78) Reviewed By:_____ Date:_____

Figure H.1.3.1
Monthly Quality Control Maintenance Checksheet

H.1.4 DETAILED MANUAL SYSTEM CHECKS

H.1.4.1 MANUAL SCAN - If you want to check the operation of your data logger, you can manually initiate a scan of all selected data channels by depressing the "RESET" switch and then "START" switch. The scan will be displayed on the LED readout like a normal scan initiated from the telemetry central. If you do not release the auto switch when initiating a manual scan, the data are transmitted on the telephone line to telemetry central. If a telemetry central scan overlaps a local scan, the dual transmission on the line "scrambles" the data and results in telemetry central receiving invalid data. Therefore, when initiating numerous local scans, place the "AUTO" switch in the out (off) position.

H.1.4.2 MANUAL MODEM TEST - The Model 9400 data logger can be made to output the first label digit to its modem and immediately input the digit through the modem to the first digit of its LED display. To perform the test, follow the procedure listed below.

1. Switch the "LOCAL TEST" switch on the rear of the data logger to the "LOC" (up) position.

2. Depress the "B" switch on the front of the data logger.

3. Depress the "RESET" switch on the front of the data logger.

4. Switch the first label thumbwheel through digits 0 to 9, and ensure each digit is correctly displayed in the first digit of the LED display.

5. If the thumbwheel number data appears in the display properly, the modem test has been successfully completed, and you should return the data logger to normal operating configuration. If the test does not yield the proper thumbwheel data on the display, a malfunction is indicated, and you should contact telemetry personnel in Sacramento or El Monte.

6. To return the data logger to normal operating conditions, switch the front panel "B" switch to the out (off) position and switch the "LOCAL TEST" switch on the rear of the data logger to the "off" position.